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Selection of Beam Angles for the National Ignition Facility (NIF)

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Abstract

The NIF has 192 beamlets arranged in 48 groups of 4. These 48 beams are arranged in 10 rings at q= {23.5, 30, 44.5, 50, 77.45, 102.55, 130, 135.5, 150, 156.5}. Indirect drive will have {4,4,8,8,0,0,8,8,4,4} beams, respectively, in each ring; direct drive will have {4,0,8,0,12,12,0,8,0,4} beams, respectively, and tetrahedral hohlraums for indirect drive will have {4,4,8,0,8,8,0,8,4,4} in each ring.

The angles 23.5, 30, 44.5 and 50 and their supplementary angles were chosen to maximize flexibility in indirect drive, so that both a 2-ring and a 3-ring hohlraum configuration could be shot. In the two-ring configuration, the 23.5 and 30 degree beams combine to form an inner ring at the hohlraum waist, and the 44.5 degree beams are moved out 190 microns to form one outer ring with the 50 degree beams. In the three-ring configuration, the 44.5 degree rings are moved in 300 microns to form a middle ring, with the 50 degree beams forming an outer ring inside the hohlraum.

The beam angles of 77.45 and 102.55 degrees were chosen to eliminate the Y20 component for directly-driven capsules; the direct-drive beam angles obey the relation 4*P2(23.5) + 8*P2(44.5) + 12*P2(77.45) = 0. Other moments are small, so that the rms of about 1% is dominated by errors from beam pointing and power balance.

Because both direct-drive and standard indirect drive capsules are insensitive to the azimuthal angles, the azimuthal angles were chosen to optimize the indirect-drive tetrahedral hohlraums. These hohlraums have potential symmetry advantages over standard indirect-drive hohlraums in that P2 through P5 can be eliminated with suitably placed beams. Although compromises with design requirements for direct and standard indirect drive hohlraums have reduced some of these advantages, tetrahedral hohlraums remains a third option for NIF.

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